AMENDMENTS TO THE DRAWINGS:

The attached sheet of drawings includes changes to Fig. 1. This sheet, which includes Fig. 1, replaces the original sheet including Fig. 1. In Fig. 1, reference numeral 6 and 8 have been inverted. That is, consistent with Fig. 2, Fig. 1 has been corrected so that reference numeral 8 refers to the Reference Video and reference numeral 6 refers to the Degraded Video.

Attachments: Replacement Sheet
Annotated Sheet Showing Changes

REMARKS

Reconsideration and allowance of this application are respectfully requested. Currently, claims 1-17 and 20-50 are pending in this application.

Information Disclosure Statement:

Applicant filed an Information Disclosure Statement (IDS) on July 7, 2009. For the Examiner's convenience, a copy of the Form PTO/SB/08a of that IDS is attached.

Objection to the Claims:

Claims 5 and 24 were objected to because of a typographical error. By this Amendment, the claims 5 and 24 have been editorially amended in accordance with the Examiner's helpful suggestion. Applicant therefore requests that the objection to the claims be withdrawn.

Rejection under 35 U.S.C. §101:

Claims 1-16 were rejected under 35 U.S.C. §101 as allegedly being directed to non-statutory subject matter. Applicant respectfully traverses this rejection with respect to these claims (as amended). In particular, independent method claim 1 has been amended to recite that the claimed "matching" and "generating" are tied to a computer system. That is, claim 1 has been amended such that the claimed "matching" and "generating" is tied to another statutory category (machine) under 35 U.S.C. §101. Claim 17 has been amended to recite a computer-readable medium. Claim 17 and its dependents are thus directed to a statutory category (article of manufacture) under 35 U.S.C. §101. Claim 18 has been canceled. Accordingly, Applicant respectfully requests that the rejection under 35 U.S.C. §101 be withdrawn.

Rejection under 35 U.S.C. §102:

Claims 1-6 and 17-25 were rejected under 35 U.S.C. §102 as allegedly being anticipated by Kuhn et al (U.S. '083, hereinafter "Kuhn"). Applicant traverses this rejection.

Anticipation under Section 102 of the Patent Act requires that a prior art reference disclose every claim element of the claimed invention. See, e.g., *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.,* 806 F.2d 1565, 1574 (Fed. Cir. 1986). Kuhn fails to disclose every claim element of the claimed invention. For example, Kuhn fails to disclose "matching, by execution of a computer system, sub-field/frame elements of a test video field/frame with corresponding sub-field/frame elements of at least one reference video field/frame, and thereby generating for the test video field/frame a matched reference field/frame comprising the sub-field/frame elements of the at least one reference video field/frame which match to the sub-field/frame elements of the test video field/frame," as required by independent claims 1 and its dependents. Similar comments apply to independent claims 17 and 20 and their respective dependents.

Claim 1 has been amended to clarify that matching of sub-field/frame elements is performed to generate for the test video field/frame a matched reference field/frame comprising the sub-elements of the at least one reference video field/frame which match to the sub-elements of the test video field/frame. Page 8, lines 9-22 of the specification support this amendment. Claim 1 is further amended to clarify that the claimed method operates to reduce the adverse effects of sub-field/frame misalignments between the reference and test sequences. Page 3, lines 2-9 of the specification support this amendment.

The invention of claim 1 provides quality assessment of a test video field or frame by comparison of sub-elements of the test field or frame with matched sub-elements of a reference field or frame, rather than of the fields or frames as a whole. In more detail, the "matching" of claim 1 involves selecting sub-field/frame elements from the reference signal that correspond to sub-field/frame elements from the test signal, even if the two elements are not aligned (either temporally or spatially). A video quality value is then generated based on

comparing the matched sub-field/frame elements, rather than the field or frame as a whole, so as to minimize the effects of sub-field/frame misalignments that are imperceptible to the human viewer. These features are not disclosed by Kuhn, and thus Kuhn fails to anticipate claim 1.

Spatial or temporal misalignment between sub-elements of the test video fields/frames and sub-elements of the reference fields/frames can greatly affect automated video quality measurements, but may be perceptually insignificant to a human viewer. By matching sub-elements within test and reference field/frames prior to the automated quality assessment, the invention of claim 1 renders such misalignments largely invisible to the automated video quality assessment apparatus. This removes a significant cause of inaccuracy in automated video quality assessment. The invention of claim 1 can improve the accuracy with which the automated apparatus emulates the human response to degraded video signals when compared with known systems.

These "imperceptible" sub-field/frame misalignments are not so severe as to be noticeable to the human viewer. However, these misalignments can nevertheless significantly affect the quality value generated by an automatic quality measuring system, such as that described in Kuhn, leading to the generation of inaccurate values. The use of a matching element that is smaller than the video field/frame size enables transient sub-field/frame misalignments to be effectively tracked. This is not identified as being a characteristic of Kuhn's quality measurement system. Indeed, no part of Kuhn discloses transient sub-field/frame misalignments.

Kuhn addresses problems that spatial or temporal misalignment between the whole of a reference and a test video sequence can cause with the automatic measurement of video quality even when these misalignments are perceptually insignificant to a human viewer. For example, col. 1, lines 43-46 of Kuhn discloses *"a high-precision image alignment detection technique to assure that corresponding* images *to be measured for picture quality <u>are aligned</u> to provide the most accurate determination of picture quality (*emphasis added)." These aligned "corresponding images" are whole images.

In more detail, Kuhn addresses problems caused by spatial and temporal misalignments with a "one off" alignment applied to the whole reference or test video sequence. For example, col. 1, lines 49-51 of Kuhn discloses *"[a]ccordingly the present invention* [i.e. of Kuhn] *provides high precision image alignment detection for providing high precision registration of two corresponding images."* Again, Kuhn fails to disclose matching <u>sub-elements</u> of two images to remove the effects of misalignments within an image.

In addition to misalignment of the whole image, more complex, but equally imperceptible (to human observers), misalignments may also occur within a field or frame, where different regions of a video field or frame might be subject to different shifts, scaling, or delay. For example, spatial warping, missing lines, or frozen blocks can result from video processing and should be taken into account of if a picture quality assessment metric is to be produced automatically to replace human subjective testing results. These sorts of misalignment are not addressed at all by Kuhn.

According to example embodiments corresponding to the invention of claim 1, the matching of elements within a field/frame may be performed in addition to, but is different from, the matching of whole field/frames disclosed by Kuhn. This is demonstrated, by way of

example, in the embodiments described in the present specification at page 7, line 30 to page 8, line 15. In these descriptions of the present specification, offsetting to compensate for misalignment between whole images (similar to that described in Kuhn) may be performed by the "crop and offset module 32." However, sub-elements of the test video fields/frames are matched with matching sub-elements of the reference fields/frames in the separate "sequence matcher module 30." Page 8, lines 9-10 of the present specification describes that sequence matcher module 30 receives as input the already cropped test reference video sequences from crop and offset module 32. Hence, the matching of sub-elements provided by claim 1 corresponds, by way of example, as an additional step to the "crop and offset module 32": which is applied to a signal in which image misalignment similar to that addressed by Kuhn has already been corrected.

The invention of claim 1 is able to compensate for movement of parts of an image relative to the image as a whole and to other parts of the image. Kuhn fails to disclose this feature. Instead, Kuhn describes compensating for movement of a whole image relative to a corresponding whole image.

Kuhn's technique relies on inserting an "alignment detection pattern" into the image (see col. 2, lines 29-31). In contrast to this insertion of an alignment detection pattern, claim 1 involves detecting misalignment of sub-divisions (i.e., sub field/frame elements) on the image itself. Kuhn's inserted pattern is not part of the image proper but replaces a part of the original image. Kuhn's system thus requires the loss of a portion of the original image which is overwritten with the inserted pattern. This renders the images processed according to Kuhn unsuitable for normal human viewing. In contrast, the images processed according to the invention of claim 1 are largely preserved.

Kuhn's inserted pattern is used to detect misalignment of the whole image, not of any part of it. It is clear throughout Kuhn that it is the whole image which is being shifted (see references to "shifting the image" or equivalent (whether by a whole number of pixels or part of a pixel) at, for example, col. 3, lines 19 and 65; col. 4, lines 5, 28, 31, 36-37, 44 and 47). There is no reference in Kuhn to shifting only a part of the image.

Applicant therefore requests that the rejection under 35 U.S.C. §102 be withdrawn.

Claims 7-16 and 26-35 were rejected under 35 U.S.C. §103 as allegedly being unpatentable over Kuhn in view of Wolf et al (U.S. '083, hereinafter "Wolf"). Applicant traverses this rejection. Claims 7-16 depend at least indirectly from claim 1 and claims 26-35 depend at least indirectly from claim 20. All of the comments made above with respect to Kuhn thus apply equally to claim 7-16 and 26-35. Wolf fails to resolve the above-described deficiencies of Kuhn.

Wolf describes a full-reference objective quality assessment method that uses feature extraction followed by quality classification. The feature extraction process requires time-alignment and includes the calculation of "temporal features." Wolf further describes the measurement of various forms of "impairment" based on features extracted from sampled video, including spatial blurring, temporal blurring, etc. The time-alignment and temporal feature extraction processes of Wolf appear to be frame-based. Wolf fails to achieve or even consider the sub-field/frame element matching of claim 1 or claim 20.

The Office Action correctly indicates that Wolf refers to statistical analysis. However, this statistical analysis is not part of the video quality assessment arrangement of Figure 2. The statistical analysis described in Wolf forms part of the development process used to design the video quality measurement system illustrated in Figure 2 (see col. 3, lines 4-6), but does not

form part of it. The statistical analysis describe in Wolf does not generate the one or more matching statistic values and/or matching vectors of claims 7 and 26 but produces a set of source and destination features which determine the internal functioning of the statistics processors 22, 24, 30, and 32 of the video quality measurement system of Figure 2 (see col. 6, lines 3-13). The statistics processors 22, 24, 30, and 32 do not generate statistical values, but compute a set of source features (col. 4, lines 26-35) and destination features (col. 5, lines 13-29). Despite their names, these functional blocks of Wolf do not perform the method of dependent claim 7 or build the system of dependent claim 26.

The method of independent claim 1 acts to minimize the effects of sub-field/frame misalignments that are imperceptible to the human viewer. Wolf fails to teach or suggest this. These "imperceptible" sub-field/frame misalignments are not so severe as to be noticeable to the human viewer, but can significantly affect the quality value generated by an automatic quality measuring system leading to the generation of inaccurate values. The use of a matching element that is smaller than the video field/frame size enables transient sub-field/frame misalignments to be effectively tracked. This is not identified as being a characteristic of the quality measurement system of Wolf. Indeed, no part of Wolf considers transient sub-field/frame misalignments.

Wolf refers to video frame features from the perspective of bandwidth-reduction. In particular, the source and destination features of Wolf are not sub-fields of a video frame, but bandwidth-reduced representations of the entire frame.

Wolf discloses extraction of features from the video signal being implemented in order to reduce the bandwidth of the signal to allow comparison of signals (source and destination) at geographically remote locations (see col. 3, lines 45-50; col. 5, lines 18-23). According to

Wolf, source features are produced by statistics processors 22 and 24 for source video and by statistics processors 30 and 32 for destination video (col. 5, lines 18-21). Col. 5, lines 32-37, discloses that "the system of the [Wolf's] present invention provides human perception-based quality parameters 13 and quality score parameter 14." These features are extracted separately from source and destination videos and exchanged between source and destination "instruments" via a communications channel distinct from the video channel. These features are generated by extracting information from the true video signals and processing that information in the hope of capturing perception-affecting characteristics for comparison.

For all of the above reasons, the invention of the independent claims provides significant benefits over Kuhn and Wolf by delivering a more effective identification of visually significant imperfections in a video signal, by excluding imperfections imperceptible to the human viewer. In particular, the invention of the independent claims can detect and treat misalignments within a video frame resulting for example, from different regions of a video field or frame being subject to different shifts, scaling or delay.

Applicant therefore requests that the rejection under 35 U.S.C. §103 be withdrawn.

New claims:

New claims 36-50 have been added. Each of these claims depends directly or indirectly from independent claim 17. Applicant submits that these claims are allowable at least for the reasons discussed above with respect to independent claim 17.

Conclusion:

Applicant believes that this entire application is in condition for allowance and respectfully requests a notice to this effect. If the Examiner has any questions or believes that an

interview would further prosecution of this application, the Examiner is invited to telephone the undersigned.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: ______________________
Raymond Y. Mah
Reg. No. 41,426

RYM:dmw
901 North Glebe Road, 11th Floor
Arlington, VA 22203-1808
Telephone: (703) 816-4000
Facsimile: (703) 816-4100

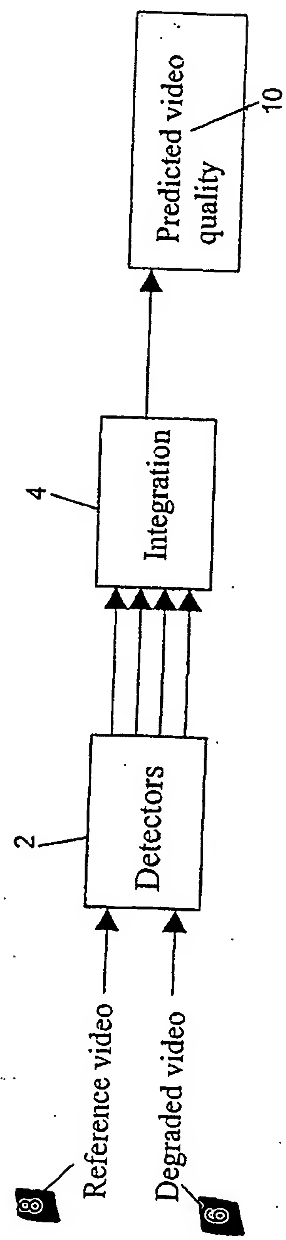
Reference video
Degraded video
Detectors
2
Integration
4
Predicted video quality
10
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Figure 1